FIFTH STREET VIADUCT
Crossing Bacon's Quarter Branch Valley on Fifth Street
Richmond
Richmond County
Virginia

HAER No. VA-67

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Northeast Region
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HISTORIC AMERICAN ENGINEERING RECORD

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HAER NO. VA-67

Location: Crossing Bacon's Quarter Branch Valley on Fifth Street, City of Richmond, ~~Richmond County~~, Virginia

UTM: 18.285120.4158560
Quad: Richmond, Virginia

Date of Construction: Constructed 1933

Engineer: Alfredo C. Janni

Fabricator: Richmond Bridge Corporation, with T.A. Loving & Company (contractor)

Present Owner: Virginia Department of Transportation
Richmond, Virginia

Present Use: Vehicular bridge

Significance: The Fifth Street Viaduct is a reinforced concrete bridge consisting of seven double-span rigid frames supported on expansion piers and stiff towers. Built in 1933 by the Richmond Bridge Corporation with aid from the U.S. Reconstruction Finance Corporation, the viaduct carries Fifth Street over Bacon's Quarter Branch valley to link the Richmond neighborhoods of Highland Park and Jackson Ward. A representative rigid frame reinforced concrete viaduct of the 1920-1940 period, the Fifth Street Viaduct is a significant multiple-span bridge designed by the prominent New York City bridge engineer Alfredo C. Janni.

Project Information: This documentation was undertaken from October 1992 through November 1992 by the Virginia Department of Transportation as a mitigation measure prior to removal of the bridge.

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Baltimore, Maryland
for the Virginia Department of Transportation

Located in the City of Richmond, the Fifth Street Viaduct carries Fifth Street across Bacon's Quarter Branch valley between the neighborhoods of Highland Park and Jackson Ward. One of five Richmond bridges built during 1933-1934 in a major public works program sponsored by the Richmond Bridge Corporation in conjunction with local authorities, the Fifth Street Viaduct has served for nearly sixty years as a critical link in the regional transportation network. A structure consisting of a series of seven double-span reinforced concrete rigid frames, the viaduct derives significance from its innovative construction as well as its history as a key Richmond bridge. The Fifth Street Viaduct has been determined eligible for the National Register of Historic Places by the Virginia Department of Historic Resources.

The Fifth Street Viaduct is 1,185 feet in length and crosses the Bacon's Quarter Branch valley, also known as Shockoe Valley, at an approximate height of 75 feet above the valley floor. Constructed entirely of reinforced concrete, the viaduct comprises fourteen 80 foot spans between two concrete abutments. The spans are carried on stiff towers and flexible expansion piers; the towers form the central supports of the double-span rigid frames, the opposite ends of which are carried on the expansion piers. The deck and flooring system consists of two longitudinal deck girders carrying reinforced concrete floor beams, floor slab, and roadway surfacing. The main girders are spaced 20 feet apart; floor beams are cantilevered on both sides of the structure in order to provide a 30 foot roadway and a four foot sidewalk on the bridge's east side.

Each of the seven stiff towers consists of two channel-shaped (or U-shaped) columns of reinforced concrete, each column being 14 inches thick. The tower columns are transversely braced by 14 inch by 18 inch lateral cross-struts spaced vertically 15 feet on centers. Individual expansion piers, which measure 14 inches by 3 feet in cross-section and varying in height, are also braced by struts, with the pier columns carried on a common concrete pedestal, which extends to the foundation mat with little increase in cross section.

The bridge abutments, also of reinforced concrete, include hollow spaces originally intended to house utility lines. At the north abutment, portions of the cut stone masonry north abutment of the original 1890 Fifth Street Viaduct (the only predecessor to the Fifth Street Viaduct) are extant. Originally built to accommodate a single street car track, the roadway surface presently carries only vehicular traffic. The reinforced concrete parapets feature chevron-pattern balustrade panels alternating with solid panels with incised rectangles. The original metal lighting standards on the viaduct incorporated trolley posts and other apparatus for streetcar operation. The few remaining light standards on the bridge feature more recent cobra-head lamps but may include portions of the original standards.

The Fifth Street Viaduct was built in 1933 to facilitate vehicular, streetcar and pedestrian travel between the neighborhoods of Highland Park and Jackson Ward in the City of Richmond. The bridge replaced an obsolete 1890 span, the Northside Viaduct, which carried streetcars only and was the first viaduct at the site. Erected during the early years of the Great Depression, the Fifth Street Viaduct was an innovative, engineered structure built largely by untrained or semi-skilled "relief" labor in a successful effort to aid the modern physical development of a major Southern city, Richmond.

Founded in 1734 near the fall line of the James River valley, the town of Richmond prospered as a port and crossroads during the eighteenth and early nineteenth centuries. During the American Revolution, the town became Virginia's capital city when Williamsburg was menaced by British troops. The pre-Civil War commerce of Richmond, including the profitable tobacco transhipment business, was largely dependent on the James River, which was usually navigable from Richmond to the Chesapeake Bay. Although the Commonwealth of Virginia during the antebellum era pushed forward a formidable array of turnpike projects under the leadership of trained civil engineers, maintenance and upkeep of the improved roads in the flat or gently rolling Coastal and Piedmont regions generally lagged behind the building of canals and railroads. Thus, by 1860, Richmonders boasted of the James River and Kanawha Canal, which permitted goods to float to and from upriver points as far west as Lynchburg. Prior to the Civil War, Richmond was also the focal point of no less than five railroads, which linked the city to Washington and points north, to North Carolina and points south, and to towns in the Shenandoah Valley.

During the Civil War, Richmond was the third largest Southern city and served as the capital of the Confederacy. Although wartime action wreaked havoc on much of Virginia, Richmond remained relatively unscathed until Lee's Army of Northern Virginia abandoned the city on their final retreat toward Appomattox and surrender. On the night of April 2-3, 1865, Confederate officials foolishly set fire to stores of tobacco and cotton in order to keep such supplies out of Union hands. The resulting fire burned much of the city's industrial and governmental area from Fifth Street on the west to Fifteenth Street on the east, and from the James River north to Capitol Square. Residential neighborhoods were left largely untouched by the blaze, which spurred a new round of commercial construction financed by local merchants with access to Northern capital. By 1876, the Beers Atlas of Richmond graphically and dramatically displayed the physical rebirth and industrial regrowth of the city.

Economic and urban development of the area surrounding the site of the present Fifth Street Viaduct had proceeded gradually but steadily since well before the Revolution. Some fifty years before the founding of Richmond itself, the prominent

Virginia planter Nathaniel Bacon established an outlying "quarter", or farm, in the vicinity of the junction of Shockoe Creek and Bacon's Quarter Branch, which was named for Bacon. In 1676, when his overseer was slain by Susquehannock Indians intent on revenging previous losses, Bacon launched a vigilante campaign against all neighboring Indians. Governor Berkeley's opposition to such extra-legal warfare sparked "Bacon's Rebellion", which ended with Bacon's death and defeat of his forces.

During the late eighteenth century, Richmond's "Poor and Workhouse" was located in the vicinity of Bacon's Quarter Branch, then just beyond the northern edge of undeveloped lots laid out as part of the growing city. By 1817, the area presently adjacent to the southern approaches to the Fifth Street Viaduct was the location of the "burying ground for white persons" that later became Shockoe Hill Cemetery. Richard Young's 1817 map also depicted the workhouse or poorhouse, and first portrayed Fifth Street as a connecting street between the Bacon's Quarter region and central Richmond. The Bacon's Quarter Branch valley floor was still occupied by farms in 1817. By 1835, burial grounds for "slaves" and for "free people of colour", as well as Richmond's "Hebrew Cemetery", were located south of the present viaduct site, in the vicinity of Shockoe Hill Cemetery.

Health-related public structures also occupied lots in the neighborhood of Fifth Street and Bacon's Quarter Branch. By 1848, the "City Hospital" was built along Hospital Street, while the old poorhouse and workhouse were replaced in 1860-1861 by the Richmond Almshouse, situated on Hospital Street between Second and Third streets. Designed by Municipal Engineer Washington Gill, Jr., the Italianate-style Almshouse served as an asylum for the city's ill and homeless poor throughout the nineteenth and early twentieth centuries. Used during the Civil War to house wounded Confederate soldiers, the building was damaged in 1865 by the explosion of a powder magazine located on the hill at the southeast corner of Fifth Street and Hospital Street. Since the 1970s, the Almshouse has been utilized as a senior citizens' home.

Richmond's nineteenth century northward expansion brought residential development, as well as construction of public structures such as cemeteries and hospitals, to the areas bounding the Bacon's Quarter Branch valley. Prior to the Civil War, free blacks settled a neighborhood known as "Little Africa" (bounded by present-day Leigh Street, Gilmer Street, Brook Road and Duval Street) to form the nucleus of Richmond's historic Jackson Ward community, characterized primarily by brick rowhouse and townhouse architecture. Home to such pioneering black entrepreneurs as financier Maggie Walker and attorney Giles Jackson, Jackson Ward included the nation's first black banks and mortgage institutions. By the 1930s, although the official "ward" designation had been abolished, the Jackson Ward neighborhood, extending east to Fifth Street, continued to be home to the majority of Richmond's black residents.

Shifting gradually away from farming, economic activity in Bacon's Quarter Branch valley itself became commercial and industrial throughout the late nineteenth and early twentieth centuries. In 1895, the Sanborn-Perris Fire Insurance map depicted a major Richmond employer, the Richmond Locomotive and Machine Works, occupying the valley floor in the Fifth Street vicinity. Valley Street (now Valley Road) bordered the factory buildings on the north. In 1900, the Seaboard Airline Railroad finished its line into Richmond, a route which utilized the Bacon's Quarter Branch valley.

By 1905, under the American Locomotive Company, the locomotive manufacturing works had greatly expanded to encompass virtually all property along the Seaboard tracks and Valley Street. The American Locomotive Company continued to operate its factory in the valley until at least 1933. By 1947, although the railroad and Valley Street remained in place, the locomotive works was replaced by six Larus and Brother tobacco warehouses and several storage buildings operated by Steel Service, Incorporated. The tobacco warehouses have since been demolished for construction of electrical transformers and the Shockoe Valley office of the Virginia Department of Transportation; however, Valley Street (now Valley Road), the rail line, and the former Steel Service Company warehouse remain at their original sites.

In the so-called "Northside", on the hills bordering the north side of the Bacon's Quarter Branch ravine, urban development was directly fostered by the introduction of streetcar travel in Richmond. In 1888, the city's old horsecar system began to be supplanted by an electric streetcar network that was the first electric transit system in the United States to operate over more than a few city blocks. Soon, enterprising companies were formed to build so-called "streetcar suburbs", or outlying communities of new homes linked to the city's commercial core by way of the new trolley cars. Formerly the Mansfield (or Mansfield Hill) estate in Henrico County, the neighborhood of Highland Park beyond Bacon's Quarter Branch was developed in 1890 by the Highland Park Company, who offered 100 lots of "the most beautiful building land in our suburbs" to prospective homeowners. After the area was annexed by the City of Richmond in 1914, further residential expansion occurred. Beyond North First Street, the adjoining community of Barton Heights originated in a similar manner during the same period.

Such "streetcar suburbanization" of Richmond's Northside immediately necessitated construction of new bridges to carry streetcar traffic over the wide Bacon's Quarter Branch valley. By means of iron viaducts with wood plank floors, north-south streets which previously terminated in Jackson Ward were extended into the new suburbs during the 1890s. Barton Heights was linked to downtown Richmond in 1891 when the Brookland Railway and Improvement Company constructed the original First Street Viaduct. By March 1891, the original Fifth Street Viaduct, also known as the

Northside Viaduct, was erected to carry Fifth Street between Richmond and Highland Park over Bacon's Quarter Branch.

The only precursor to the present Fifth Street Viaduct, the old Northside Viaduct on Fifth Street was touted in advertisements of the Highland Park Company as "a splendid iron structure 40 feet wide and 1200 feet long, costing about $80,000...". Although the original Fifth Street Viaduct was patently a structure of great civic importance, the City of Richmond and Henrico County chartered the viaduct as a private concern. The Henrico County charter permitted the bridge's owners and sponsors to charge tolls not exceeding 5 cents per person, 3 cents for each horse, mule, cow, or vehicle's wheel, and 1 cent for every sheep or hog. The charter also specifically allowed streetcars "to run over the bridge on terms acceptable to the owners. On August 16, 1890, the Northside Land Company and the Highland Park Company awarded the original Fifth Street Viaduct contract to a prominent American bridge-building firm, the Edgemoor Iron Works of Wilmington, Delaware.

The original Northside or Fifth Street Viaduct was completed by Edgemoor in February 1891. The structure consisted of a series of iron or possibly steel bents (they were identified as steel during the 1933 replacement of the bridge) supporting a deck which carried a vehicular roadway, a walkway, and double-tracked street railway. On August 17, 1890, the Richmond Dispatch admiringly noted that "there will be no necessity of sign-boards warning persons that they will be fined if their teams go over the viaduct at a faster gait than a walk, for it will be capable of sustaining 100 pounds to the square foot of floor, and teams can go over it at a trot; also, it will have a capacity of two thirty-ton electric-motor cars passing each other at any point." Under management of the Highland Park Company, the Richmond and Manchester Railway Company, and their successors, the original Northside or Fifth Street Viaduct continued in full service until 1933, when it was replaced by the present Fifth Street Viaduct. Remnants of the cut stone masonry north abutment of the first Fifth Street Viaduct are still extant at the north approach to the present structure.

Planning for the construction of the current Fifth Street Viaduct began during the early 1920s, when Richmond municipal authorities began to assess the adequacy of the city's older bridges in coping with the new traffic demands of the early twentieth century. Lagging behind most other major Southern cities in development of a municipal planning arm, Richmond entered the automotive era somewhat hobbled by its lack of a comprehensive city plan and its traditional reliance on private enterprise to improve services to the suburbs. Prior to 1940, according to longtime Mayor Fulmer Bright, planning in Richmond was "distinctly an engineering problem," involving strictly the extension of municipal services to new neighborhoods. The city's overworked Public Works Department thus took the lead in the field of construction and extension

of the local infrastructure. Under the leadership of Allen J. Saville, a prominent Richmond engineer who served as the department's Director from 1921 to 1925, public works engineers planned for the upgrading or replacement of the city's old bridges, including the Fifth Street Viaduct.

With a professional specialty in "layout of industrial and residential sub-divisions" as well as "municipal engineering," Saville pushed officials and the public toward consideration and adoption of a bridge construction program to improve suburban access to the old downtown business core. Richmond's late start in planning and public financing of modern transportation facilities, however, caused difficulties and delays which affected the replacement of the old Fifth Street Viaduct. An August 19, 1926 ordinance extended the franchise and ownership rights of Virginia Electric and Power Company (by then the major streetcar company in Richmond) in the Fifth Street Viaduct, the First Street Viaduct, and the Marshall Street Viaduct, but reserved the right of the city to take over the structures without cost by August 19, 1931. On February 13, 1929, the City Council resolved "to appropriate funds for the construction of a bridge across Bacon Quarter ravine at or near Fifth Street." The Council also authorized "a survey of the cost of acquisition, the cost of proper repair, and the cost of safe approaches as to each bridge or viaduct in the City of Richmond, not owned by the City of Richmond."

R. Keith Compton, Saville's successor as Director of Public Works, replied to the latter resolution with a full-fledged "General Bridge Program" of May 9, 1929. Noting that the city would need to spend some $6.5 million to repair or replace the nineteen bridges under study, Compton suggested that "the City's present financial condition, as indicated by the real estate market and building activities of the past year, makes it advisable that we extend the bridge construction program over a period of years that would not interfere with the carrying out of improvement necessities." Compton nonetheless strongly urged that Richmond make every new bridge "a type intermediate in cost, substantial in design, neat in appearance but unornamented, built to serve at least a reasonable number of years after maturity of bonds issued for the purpose of its construction."

Regarding the original Fifth Street Viaduct, or Northside Bridge, built in 1890-1891, the General Bridge Program of 1929 had little positive to say. The report observed that, for light steel structures especially, "often times the service life of a bridge is even shorter than its physical life, due to obsolescence brought about by steady improvements and enlargements of trucks, busses and interurban electric cars, and their consequent increasing load capacity." The Fifth Street or Northside Viaduct, the original First Street Viaduct, the Ninth Street River Bridge, and the Lombardy Street Bridge over the Seaboard Airline Railroad were Richmond's notable examples of such

obsolete spans. Compton recommended that the city exercise its right to acquire the original First Street Viaduct, the original Fifth Street Viaduct, and the Marshall Street Viaduct before August 19, 1931, but found that "the structural parts of the First and Fifth St. Viaducts are without value to the City, even as a gift...". Maintenance of the two bridges, in fact, was "a serious burden to these owners," but the city might have some interest in the Fifth Street Viaduct right-of-way (the First Street right-of-way was considered "badly located").

Compton thus urged that the Fifth Street Viaduct should be replaced "within a reasonable time" after the city acquired it from the streetcar company. The General Bridge Program favored an unspecified type of reinforced concrete structure for the replacement and estimated the cost of new construction at $600,000. The report also prophetically recorded the suggestion that "the City of Richmond might construct some of these bridges and operate them for a while under the toll system, applying the receipts toward carrying charges on the bond issue." For the City Council's reference, Compton helpfully provided comparative statistics on municipal toll bridges from the U.S. Bureau of Public Roads.

Between 1929 and 1932, Richmond's economic outlook worsened as the nation slid deeper into the Great Depression. Municipally-funded projects, such as new bridge and sewer construction, were indefinitely delayed; the Department of Public Works was forced to lay off numerous employees and abolish or combine existing divisions. On the lookout for other funding sources and determined to advance the General Bridge Program toward completion, officials in 1932 were thus receptive to the plans of State Senator John J. Wicker and retired Public Works chief Allen Saville, who proposed a novel public-private partnership to build no less than six bridges (including a new Fifth Street Viaduct) in the downtown Richmond area. Wicker and Saville offered to form a bridge-building company for the purpose of securing a public works loan from the U.S. Reconstruction Finance Corporation (RFC), the earliest Federal agency established expressly to alleviate Depression era distress.

The terms of such a "self-liquidating" loan would require Wicker's and Saville's special firm, the Richmond Bridge Corporation, to contract for professional design of the bridges with municipal review, to employ as many unskilled or semi-skilled laborers as safety allowed on the job (labor-saving devices and workforces wholly comprised of skilled labor being discouraged with so many ordinary workers needing work), and to apply tolls collected on the bridges toward the eventual liquidation of the loan balance. Thus, the City of Richmond would fulfill the goals of the General Bridge Program, yet pay little more than the cost of design review, general supervision, and possibly toll-keepers' salaries. The proposed arrangement appeared ideal to Richmond authorities, who gave Wicker and Saville enthusiastic approval to proceed with their

plans.

Wicker's and Saville's plans involved an ambitious array of individual bridge-building projects. The centerpiece of the anticipated program would be a new high-level, multiple-arch bridge spanning the James River between Belvidere Street in downtown Richmond and Cowardin Avenue in Manchester (South Richmond). On the Richmond side, Second Street would be extended over the Chesapeake and Ohio Railroad freight yards to meet the Belvidere Street approach to the James River span via a new viaduct. On the south side of the river, another new bridge would carry Cowardin Avenue over Atlantic Coastline tracks toward the James River Bridge. The old steel Marshall Street Viaduct, carrying Marshall Street over the Shockoe Creek Valley, would be rehabilitated and strengthened, while on the Northside the two old streetcar bridges, the original Fifth Street Viaduct and original First Street Viaduct, would be completely replaced.

With its plans maturing in 1932, the Richmond Bridge Corporation and its key loan application gradually took shape. Befitting its public function, the firm was openly organized and staffed by influential Richmond officials and engineers well-connected at City Hall and the State Capitol. The president of the company was John Jordan Wicker, Jr., a remarkable promoter and politician who served in the Virginia State Senate from 1932 to 1936. A Kentucky native, Wicker earned a law degree at the University of Richmond and flew with the Army Aviation Corps in World War I. A co-founder of the American Legion, he led 25,000 American legionnaires to Paris in 1927 in a gathering described by the Richmond News-Leader as "the largest peacetime overseas convention in history." As a Democratic Virginia State Senator during F.D.R.'s first term, Wicker obtained more than $1 million for Richmond roadbuilding projects (he also served as Director of the Virginia office of the Federal Home Owners Loan Corporation). Active in local barbershop quartets as well as professional legal circles until his death in 1985, Wicker also served as an adviser to the city's Monument Avenue Commission, which erected statues and memorials to numerous Confederate Civil War generals.

As Vice President of the Richmond Bridge Corporation, Allen J. Saville carried great weight in municipal and state engineering councils. First listed in the 1915 Richmond City Directory as president of Saville & Claiborne "consulting engineers," Saville in 1921 became Richmond's Director of Public Works, a post he held until 1925. In addition to advancing the General Bridge Program, Saville's leadership of the Department of Public Works saw completion of a major Shockoe Creek Sewer system, which included the controlled sewering of Bacon's Quarter Branch. In 1925, Saville became president of Allen J. Saville, Inc., Engineering and Construction, a position he held until his death in 1946. Often rumored for appointment to high public works posts

in Virginia, Saville built a regional reputation as a civil engineer specializing in "municipal engineering," studies of factory efficiency, "construction of all kinds of buildings," and "layout of industrial and residential sub-divisions" (among his notable suburban designs was Windsor Farms on Richmond's West End).

Also serving as vice presidents at the Richmond Bridge Corporation were R. Keith Compton, who continued in his post as Richmond's Director of Public Works, and Horace L. Smith, Jr., whose firm of Lee, Smith, Vandervoort, Inc., worked in conjunction with Saville's own concern in developing a plan for the bridge projects. Beginning as a "theatre architect" in Richmond in 1924, Smith formed his engineering firm a year later in partnership with Merrill Lee, another Richmond-based architect, and James Vandervoort, a former "sales engineer" with Truscon Steel Company. Lee, Smith, Vandervoort continued in business until at least 1936; in 1938, Lee and Vandervoort were officers of the Auto Ramp Corporation, while Smith served as president of Canadian Thermo-Vactor, Ltd., a thermal engineering company.

Realizing they needed a knowledgeable design engineer in order to plan a bridge-building program on such a large scale, officials of the Richmond Bridge Corporation hired the distinguished bridge engineer Alfredo C. Janni of New York City. Born in 1870 to a noble Neapolitan family (he bore the title of Count, but preferred not to use it), Janni graduated from the University of Naples, where he served for two years as Assistant Professor of Steel Construction before coming to the United States. As Assistant Bridge Engineer with the Southern Railway, he designed and supervised construction of many steel and reinforced concrete bridges. Between 1907 and 1914, Janni was Assistant Bridge Engineer for the City of St. Louis, where in 1910 he designed the Kings Highway Viaduct. In 1914, he served as the New York State representative to the Engineering Congress in Phoenix, Arizona.

Janni came to further prominence when the Businessmen's and Taxpayer's Association of Buffalo commissioned him to design a reinforced concrete bridge to be built between Buffalo and Fort Erie in Canada. During World War I, the United States Shipping Board accepted Janni's plans and designs for concrete ships. Throughout his career and until his death on February 26, 1938, Janni frequently contributed to professional bridge engineering publications. One of his primary interests lay in the study of the elastic capabilities of reinforced concrete under temperature and load stresses. A 1913 article he authored for the Journal of the Western Society of Engineers introduced into American bridge engineering literature the subject of bridges with elastic piers. Later Janni articles for the Transactions of the American Society of Civil Engineers dealt with the principle of the "ellipse of elasticity," as applied to the construction of arch bridges.

Janni's involvement in the Richmond bridge-building program as consulting and design engineer may have favorably influenced the Board of the U.S. Reconstruction Finance Corporation, which approved a loan of $1.7 million to the Richmond Bridge Corporation on November 30, 1932. Local newspapers lauded Wicker, Saville and Smith, and praised the loan approval as one major triumph of the city's "greatest November" (other achievements of the same month included agreement on improvement of the James River, the raising of a record Community Fund, and the opening of the Richmond Symphony Orchestra). Noting that "reinforced concrete construction was contemplated from the first" due to the local availability of all materials and labor, the Richmond News-Leader observed that "the erection of the bridges at this time when construction costs are abnormally low will enable the project to be completed at a saving of more than a million dollars compared with what the cost would be under normal conditions." Initial government studies showed that tolls would repay the loan in 15 years, the News-Leader reported, but Richmond could also simply acquire the bridges at any time by paying off the balance of the loan.

In late 1932 and early 1933, while the Richmond Bridge Corporation pushed forward its plans, the City of Richmond acted quickly to lay the necessary legislative framework for the bridge construction. On December 21, 1932, the City Council directed public advertisement of a draft ordinance which would allow Virginia Electric and Power Company to convey the original Fifth Street Viaduct, the original First Street Viaduct, and the Marshall Street Viaduct to the Richmond Bridge Corporation, reserving the right to operate streetcars, busses, and utility lines over the bridges. The draft ordinance was approved and passed in final form on January 13, 1933.

Other ordinances of January 3 and March 17, 1933, formally granted Richmond Bridge Corporation the right to construct the five new bridges and rehabilitate the Marshall Street Viaduct. Amending the January 3 legislation in order to permit the bridge company to remove the old viaducts, the March 17 ordinance specifically authorized construction of a new Fifth Street Bridge:

> To acquire from the present owner thereof the Fifth Street Viaduct crossing Shockoe Valley and beginning, at its southern terminus, at a point approximately two hundred and sixty feet, more or less, north of the intersection of Fifth Street and Hospital Street and extending to its northern terminus at a point approximately in Court Street south of Rockingham Street, together with all necessary rights of way, easements, franchises, privileges and appurtenances appertaining thereto; to demolish said viaduct and close traffic, with the approval of the Director of Public Works, for such period as may be necessary during construction and/or improvement work; and to construct and operate in approximately the same location a new concrete bridge.

The city also required the bridge corporation to include space for public utilities (gas, water, and electricity lines) in the bridge piers, towers, and abutments. Workers hired by the Richmond Department of Public Works and paid with available relief funds would remove the old viaduct and offer a potential labor pool to the Richmond Bridge Corporation.

The requirement that the new Fifth Street Viaduct (as well as the other four new spans) be a reinforced concrete bridge reflected a preference for a cost-effective yet durable bridge type whose reliability had been thoroughly demonstrated by 1933. Although concrete construction has been dated to ancient times, the modern application of concrete in bridge building occurred almost simultaneously with that of steel. Initially, bridge construction in concrete involved adaptation of traditional masonry arch construction techniques to the new material. Early accomplishments in the United States included the 1871 Prospect Park Bridge in Brooklyn, New York (a non-reinforced concrete example) and the 1889 arch built in Golden Gate Park in San Francisco (the first known reinforced concrete arch constructed in the United States).

Basic reinforced concrete construction methods involved erection of a temporary structure and framework to hold and shape the placed concrete prior to its hardening. All metal reinforcing bars had to be connected and in position before the concrete was placed. Formwork was generally removed after a stipulated hardening period (frequently 28 days). As concrete bridge innovator Edwin Thacher noted in 1889, the durable yet plastic nature of concrete allowed engineers and architects to build structures that were at once highly useful and attractive to the public.

Once the feasibility of iron and steel reinforcing of concrete was demonstrated in Europe and the United States, technology rapidly advanced between 1890 and 1910. Used in the form of rolled beams or bars, metal reinforcement added tensile strength to the compressive strength of concrete. Variously deformed or twisted to achieve greater adhesion with the surrounding concrete, reinforcing bars in a wide range of patented schemes were an important component of most reinforced concrete highway bridges by the first decade of the twentieth century. The growing "good roads" movement in the United States and the creation of state highway commissions prompted the American Society of Civil Engineers and the American Concrete Institute to issue standards for concrete bridge design and loading during the period 1904-1913.

By the early 1920s, as the potential of reinforced concrete was fully realized, American bridge-building had entered a period of standardization. This period was punctuated by the introduction of several new bridge types from European origins. Among these were the through, or "Rainbow" arch, bridge and the rigid frame bridge.

Drafted by Alfredo Janni and his firm's design engineer S.C. Jemian in February 1933, surviving as-built plans for Richmond's Fifth Street Viaduct show the configuration of the structure as a series of double-span rigid frames, supported by stiff towers and elastic expansion piers, with expansion joints located on the deck at those piers.

Janni's choice of the double-span rigid frame as the basic construction unit of the multiple span Fifth Street Viaduct was grounded in his knowledge of the numerous advantages offered by the type. Ranked by bridge historian David Plowden as a key reinforced concrete bridge engineering advance of the twentieth century, comparable to the later development of prestressed concrete, the rigid frame bridge was pioneered by German engineers and the Brazilian Emilia Baumgart. It was introduced to the United States primarily through Westchester County engineer, Arthur G. Hayden's Swain Street Undercrossing, the first of many short-span rigid frame bridges Hayden built for the Bronx Parkway Commission in 1922-1923.

Unlike other reinforced concrete spans, in which the superstructure and the substructure were not designed as a continous unit, the rigid frame bridge as built by Hayden and his associates was a continuous structure "from footing to handrail" (as the Engineering News-Record editorialized in April 1926). An instructive 1933 booklet prepared by the Portland Cement Association noted that in a rigid frame structure, "the bearing is replaced with concrete that continues monolithically from the abutments into the deck, [so that] the altered structure becomes a frame with rigid corners." Observing that "it is generally simpler and more economical to build a concrete bridge continuous than otherwise," the Association also found that "the moments are small in the sections near the center of the deck of the rigid frame bridge compared with the corresponding moments in a simply supported deck of the same span length." The result was that "frame sections can be reduced and the bridge floor made exceptionally shallow at the center of the span."

The Portland Cement Association declared in their 1933 Analysis of Rigid Frame Concrete Bridges that because the rigid frame structure could be built with a shallow section, "substantial reductions are obtained in volume of embankment fill or excavation, and in area of land required for the approaches." Maintenance expense was also advantageous because the rigid frame bridge was a monolith, in which "the various details where the deck bears on the abutments are eliminated." The Association declared that rigid frame reinforced concrete highway bridges with solid decks were economical up to a span length of about 70 feet, while for longer spans "the ribbed deck construction is preferred on account of its lightness." As of September 1933, the longest rigid frame concrete span in the world was the 224 foot main span of the Herval bridge in Brazil.

During the early 1930s, rigid frame bridge design and analysis was the subject of specialized treatises such as Arthur Hayden's The Rigid-Frame Bridge (1931) and Hardy Cross's and Newlin Dolbey Morgan's Continuous Frames of Reinforced Concrete (1932). These texts stressed the fact that the supporting members in a rigid frame bridge provided flexure and worked as a unit with the superstructure, while such members in the non-rigid frame structure simply carried a deck at a certain desirable clearance above a roadway or watercourse. Victor Brown and Carleton Conner in their 1931 work Low Cost Roads and Bridges observed that "rigid frame bridges constructed of concrete possess great inherent strength and rigidity which insure their safety;" from the nature of their construction, "any overloading of one part of the bridge simply causes the stresses to be transferred to other parts until a balance is obtained."

By 1939, the authoritative Taylor, Thompson and Smulski text Reinforced-Concrete Bridges included "multi-span rigid frames in which the girders forming the superstructure are rigidly connected with elastic vertical supports" as one of four main choices available to the engineer designing a multiple span reinforced concrete girder bridge. The other options were "a number of simply supported girder spans," "a combination of girders provided with cantilevers and short spans supported by these cantilevers", and "continuous girders supported by independent piers". Recommending the rigid frame design for use "where vertical supports of the bridge are elastic, as in viaducts," the authors enumerated several advantages of rigid frame bridges over simply supported girder spans: (1) rigid frame structures required less steel and concrete; (2) the center of the span could be much shallower; (3) fewer expansion joints were required; (4) deflection and vibration were considerably reduced; (5) no bearings were required at the supports, and; (6) "owing to rigid connections between the vertical supports and the horizontal members, the stability of the vertical supports in rigid frames is much greater than that of independent piers."

Taylor, Thompson and Smulski also noted certain disadvantages of rigid frame bridges including: (1) rigid frames were suitable only at sites where unyielding foundations could be ensured, for uneven settlement produced a "bad effect" on their strength; (2) placing of steel reinforcement in the concrete required considerable skill; (3) the sequence of concrete placement and removal of formwork was sometimes more complicated; and (4) design of rigid frame bridges was somewhat more complex because such structures were "statically indeterminate", and analysis was not as straightforward as statically determinate, simply supported spans. In the hands of a competent engineer, the authors asserted, these disadvantages disappeared.

Alfredo C. Janni and the engineers of the Richmond Bridge Corporation designed the Fifth Street Viaduct, as well as its neighbor the First Street Viaduct, as a multiple-span reinforced concrete viaduct consisting of a series of double-span, rigid frame

units. The as-built plans for the Fifth Street Viaduct depicted seven such double-span units, each 160 feet in length between expansion piers, with stiff towers as central supports. The concrete footings for the towers and piers were to be carefully located beneath the crowded, Bacon's Quarter Branch Valley floor, which included the Seaboard Airline Railroad, the sewer carrying the enclosed stream, Valley Road, and a large array of buildings and railroad tracks owned by the American Locomotive Works.

The deck of the new Fifth Street Viaduct was to be carried on a ribbed system of two large longitudinal girders, transverse floor beams, and intermediate stringers, with the floor beams cantilevered out to support a single sidewalk on the east side only. The bridge was built to carry two lanes of automotive traffic, on an asphalt wearing surface, flanking a single set of streetcar tracks, atop a brick wearing surface. The trolley tracks and their brick wearing surface were removed or paved over since the termination of Northside streetcar service in the 1960s.

The underside of the deck also featured small concrete brackets, apparently intended to eventually support transverse steel beams or additional bracing, illustrated on the original plans but not called for in the original contract (these beams were never installed). Designed to meet the Virginia State Highway Commission Standards of 1932, expansion joints were placed in the viaduct at the expansion piers where adjacent double-span rigid frame units met, in order to alleviate stresses due to temperature-related expansion and contraction. Proper water drainage, a necessity in reinforced concrete construction, was handled by means of a network of gutters, drains, catch basins and scuppers.

The spare ornamentation of the Fifth Street Viaduct reflected its origins as a cost-effective, Depression era structure. The abutments, the U-shaped walls of the seven stiff towers, and the more slender elastic piers were wholly unornamented. The roadway, however, was flanked by low, reinforced concrete parapets featuring a panel design, with each 80 foot span length characterized by solid panels flanking a group of six open panels in a chevron-like pattern. Additional, simple ornamentation was provided by metal light standards, which included opalescent lamps hung in a graceful curve. The light standards doubled as carriers of trolley poles and guy wires; standards are still extant, but the lights are now largely altered by removal of the brackets and hanging lamps and installation of modern cobra-head illumination. Manhole covers also were designed with a simple geometric pattern; one is still extant on the sidewalk at the Viaduct's north end.

Pursuant to the agreement among the Richmond Bridge Corporation, the City of Richmond, and the Reconstruction Finance Corporation, a single, small painted

tollhouse was erected at the southwest end of the Fifth Street Viaduct. With 8 inch thick stuccoed cinder block walls and a projecting hipped roof, the tollhouse was intended as a sturdy structure that would weather the elements as well as potential automotive collisions. Signage on the bridge directed motorists to "stop" and "pay toll", and reflectors and a special high-intensity lamp aided recognition of the tollhouse during the night hours.

With most design drawings for the Fifth Street Viaduct finished in February 1933, the Richmond Bridge Corporation awarded the contract for construction of the bridge to T.A. Loving & Company of Goldsboro, North Carolina. By May 5, 1933, all building materials had been ordered, and laborers provided by the City of Richmond under relief funds were at work preparing the approaches. Actual construction on the viaduct began on Wednesday, May 10, 1933. By May 19, over 100 workers were engaged in readying the abutments for the new structure, with the old 1890 viaduct still in place but periodically closed to traffic. As Richmond newspapers gladly reported, the Fifth Street Bridge project, in conjunction with the other five Richmond Bridge Corporation bridge jobs begun at approximately the same time, helped reduce the city's unemployment rate by 17 percent during the five months from January to May 1933.

A June 6, 1933 Richmond Times-Dispatch article detailing a wild, near fatal "whiskey car" chase up Fifth Street (Prohibition did not officially end until December 5, 1933) revealed the fact that workers had by that time torn down about half the old Fifth Street Viaduct from the Highland Park side south. By the end of June 1933, approach work for the new structure was largely finished. On July 17, 1933, the Fifth Street Bridge work was about 22 percent completed, and the unskilled, racially integrated relief labor force previously employed on the project was giving way to more experienced, skilled and semi-skilled laborers. On September 24, the bridge was approximately 70 percent finished; four days later, the Reconstruction Finance Corporation appointed engineer H.E. Whittaker as the "authorized representative" from the RFC Engineering Board to the Richmond Bridge Corporation.

On December 9, 1933, the First Street Viaduct, twin of the Fifth Street Bridge, formally opened to the public. The same day, noting that the Fifth Street span was scheduled to open on December 23, the RFC granted a Richmond Bridge Corporation request to operate the two new Northside viaducts free of tolls from their openings to January 1, 1934. RFC Inspector Whittaker noted that, since free public roads existed for travel from Highland Park and Barton Heights to downtown Richmond, the bridge firm felt "it would be good advertising" to begin with a toll-free grace period.

On December 23, 1933, after several days of preliminary streetcar usage, the Fifth Street Viaduct opened for all forms of travel. A highlight of the opening ceremony

was longtime Highland Park resident Mrs. E.E. Whiting's ride over the bridge in a buggy driven by Wirt Quarles, last mayor of Highland Park before its annexation by Richmond. In tandem with the five other Richmond Bridge Corporation projects all completed by the end of 1934, the Fifth Street Viaduct's design and construction was praised by professional engineering journals of the era. Alfredo Janni's design engineer S.C. Jemian concisely described the structure in the October 1933 issue of Civil Engineering, noting that the double-span rigid frames in the bridge "were analyzed as such for full vertical loading and variation in temperature of 40 degrees C." Jemian and the editors of Engineering News-Record, who described all the bridges of the Richmond bridge program as having "outstanding interest" in the issue of June 6, 1935, noted that the expansion provisions were a predominant feature of the Fifth Street and First Street viaducts.

The Fifth Street Viaduct has spanned Bacon's Quarter Branch valley since 1933 with few changes to its original design. Streetcar traffic ended on the bridge during the 1960s, and the tracks and attendant trolley lines were evidently removed at that time. The utility openings added to the abutments, piers, and towers are still extant but do not now house or support any utility lines. In August 1935, after two years of local complaints, toll collection ended on the bridge. Recognizing that toll receipts barely covered toll keepers salaries and did not come close to liquidating the RFC loan of $1.7 million, the City of Richmond agreed to retire the debt of the Richmond Bridge Corporation through annual cash payments, provided the bridge company operated the viaduct as a free bridge. The balance of the RFC loan was finally repaid in 1946, through tolls charged on the major James River Bridge (Lee Bridge) built by the Richmond Bridge Corporation.

On July 17, 1941, at the urging of City Council member John Hirshberg, the Fifth Street Viaduct was officially renamed the "Stonewall Jackson Memorial Bridge." The bridge has served in its key location since its construction in 1933, and continues to link the Northside neighborhood of Highland Park with Jackson Ward and downtown Richmond south of the Bacon's Quarter Branch valley. The Virginia Department of Transportation plans to replace the bridge; the project includes the viaduct's replacement and improvements to the existing approaches.

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